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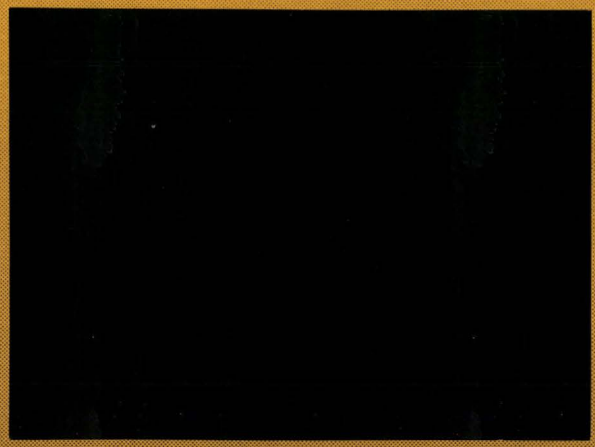
FOREST PEST MANAGEMENT



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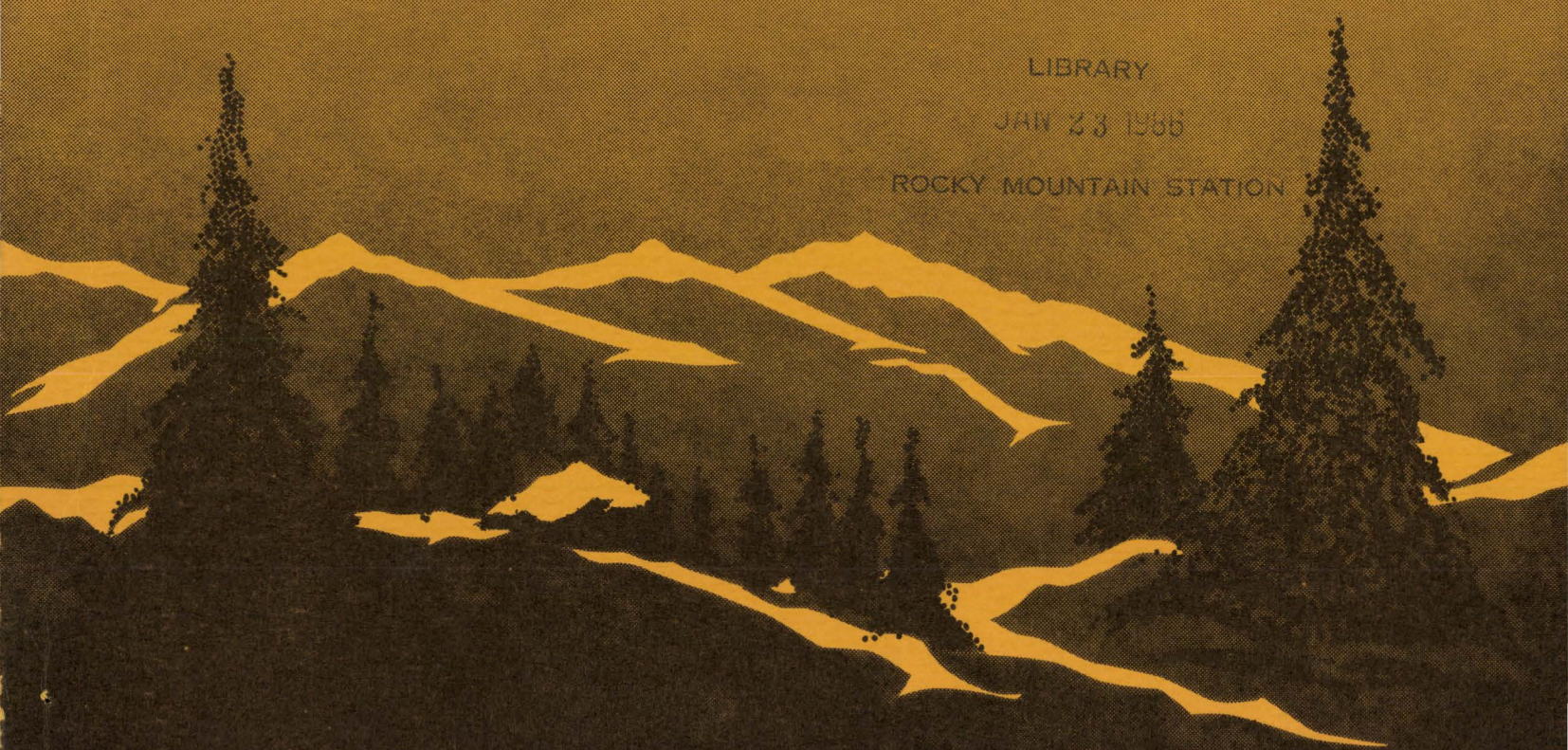

United States
Department of
Agriculture

Forest Service

Forest Pest Management
Denver, Colorado

BIOLOGICAL EVALUATION R2-85-4

HIGH COUNTRY INTEGRATED PEST MANAGEMENT PROJECT

POST-SUPPRESSION EVALUATION

1985

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ABSTRACT

A significant decline in mountain pine beetle populations occurred throughout the High Country Project area in 1985. This decline provides an opportunity to shift management emphasis from suppression to stand management. If the primary goal is the maintenance of the lodgepole pine cover type within the project area, then about 14,000 acres need to be regenerated each decade. If the primary goal is to substantially reduce the susceptibility of the cover type to mountain pine beetle, then about 51,000 acres need to be regenerated each decade.

INTRODUCTION

In 1983 the basic strategy for the "High Country Integrated Pest Management Project" was formulated by an interagency task force (Averill and Leatherman 1983). The strategy and accepted silviculture prescriptions are displayed in Appendix A and B, respectively. In April 1984, the executive council of the HCIPMP accepted this strategy and issued a statement of purpose and basic strategy[1/]:

1/ Colorado State Forest Service memorandum (April 27, 1984)

HIGH COUNTRY INTEGRATED PEST MANAGEMENT PROJECT STATEMENT

OF PURPOSE AND BASIC STRATEGY

The forest resources of Summit, Eagle and Grand counties are currently under attack by Mountain Pine Beetle (MPB). Beetle epidemics, though not completely understood, are one of nature's processes (along with wildfire) for regenerating mature pine forests. However, human desires are often not compatible with these natural processes. Management, through application of proven and demonstrated techniques, can modify the forest cycle of regeneration, growth, maturity, and death, thus maintaining a level of growth that reduces the potential of catastrophic tree mortality. The forests can be managed to perpetuate the beauty, wildlife, and recreation opportunities, as well as watershed and timber values. The choice is clear. Either man consciously manages the forest or allows "nature" to do so in a helter-skelter fashion.

Mountain pine beetle does not respect property lines or jurisdictional boundaries existing between various government jurisdictions. The Executive Council, representing these various agencies and interests, is integrating management activities toward the common goal of solving the MPB problem in this area under a single project organization, with coordination and direction provided by a Project Manager.

The Council recognizes individual agency policies that limit management actions on particular agency lands. However, it is the intent of the council member agencies to fully support the Statement of Purpose and Basic Strategy within the framework of individual agency policies and private landowner objectives.

PROJECT GOALS:

1. Minimize adverse impacts of MPB by establishing vigorous insect and disease resistant forests.

2. Maintain, or improve, scenic and recreation qualities.

3. Maintain, or improve, wildlife habitats.

4. Reduce wildfire hazards.

5. Salvage infested and dead lodgepole pine.

ASSUMPTIONS:

1. MPB can be managed to minimize its adverse impacts on the various forest resources.

2. Removal of infested trees through timber sales is the preferred direct control method. Direct control with chemicals is a viable tactic in areas of relatively high value.

3. Prevention of MPB attack with chemicals is feasible on individual high value trees.

4. Prevention of MPB infestation of stands through silvicultural manipulation is feasible where values at risk support that decision.

5. All lodgepole pine stands, regardless of ownership, can be stratified according to risk and value, thus allowing treatment priorities to be set and to guide choice of suitable tactics.

BASIC STRATEGY:

The strategy is to integrate all available management tactics for the host forest type to meet objectives of each of the various agencies and private landowners.

Under current conditions the greatest benefit appears to be from silvicultural treatment of those areas where beetles are not yet present, or are at relatively low levels. However, in areas of high beetle population, reduction of those populations may be required.

Harvest and sale (salvage) of currently infested trees is the preferred method of direct control. Chemical control may also be needed when infested trees cannot be moved before beetle emergence and flight.

There appear to be net benefits from continuing with chemical control efforts in those higher value areas where the beetle is present.

All treatments will be planned and implemented according to joint operating plans drawn up by all agencies. These plans will be made according to a system of stand stratification and prioritization to be developed by an interagency technical task force.

Public recognition of the need for forest management on all ownerships in order to maintain or improve the benefits of these forested lands is a principle goal.

The objectives of this evaluation are:

1. To assess treatment effects on mountain pine beetle populations within the project area.

2. To assess population trends outside designated control areas.

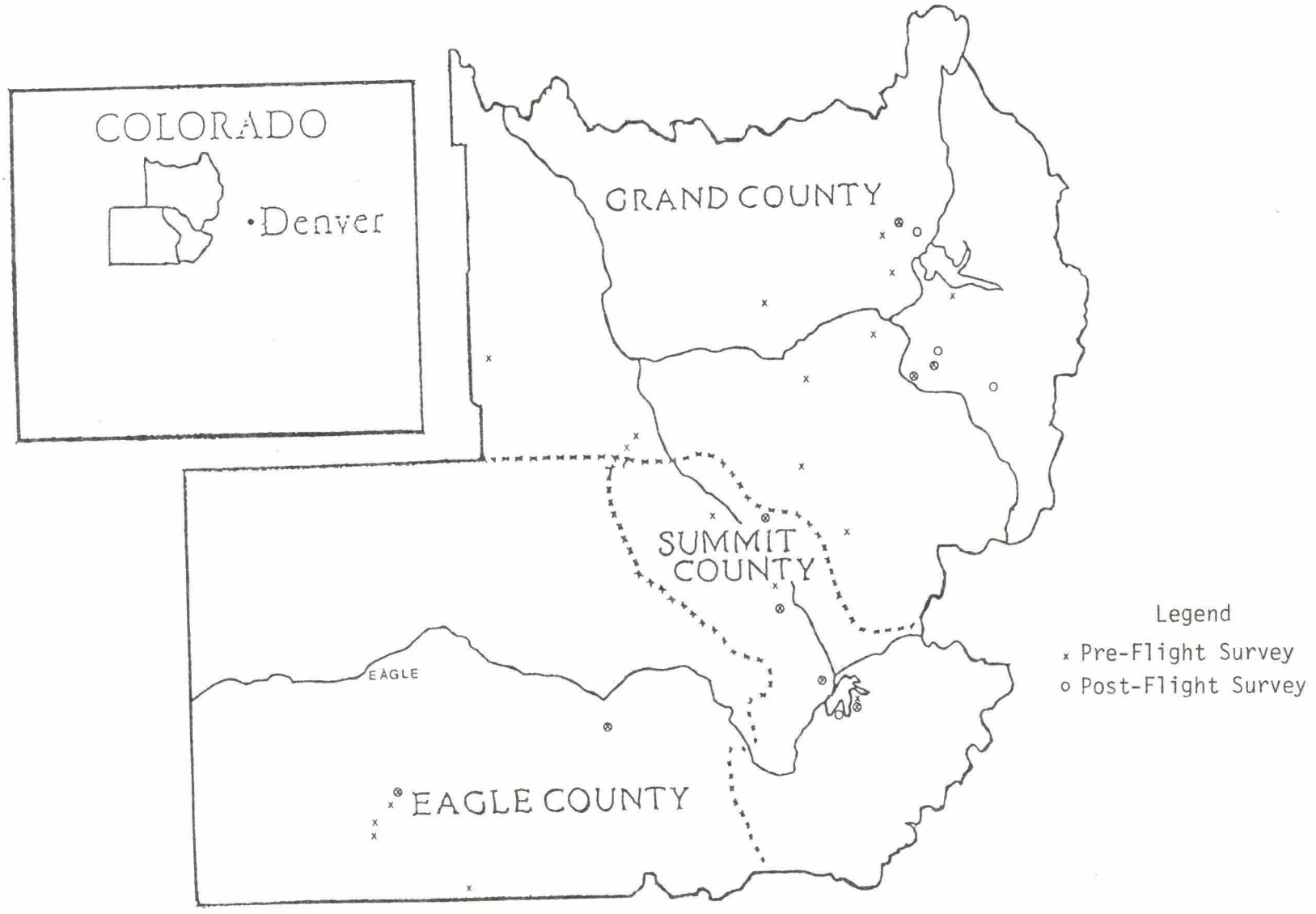
METHODS

Twenty-seven areas (Figure 1) were surveyed in July 1985 to determine mountain pine beetle infestation trend for the upcoming fall flight. Two six by six inch bark samples were examined from each sample tree for total number of mountain pine beetle brood. A sequential sampling scheme (Cole 1964) was used to determine whether populations were increasing, decreasing or static.

In addition, twenty areas (Figure 1) were surveyed in September and October to estimate the trend and post-flight level of mountain pine beetle infestation. In each area stands, cutting units or treatment areas were surveyed using one chain wide strip cruises. The length of the cruise line was determined by the total area to be examined. On each line the diameter of each attacked tree was tallied by year of infestation. Pitch-outs were tallied only for 1985 attacks.

Trees per acre attacked was computed for each area surveyed. The mean trees per acre attacked was used to provide the area estimate. Sample sizes were too small ($n<30$) to calculate reliable standard errors and confidence intervals. Attack ratios were based on the trees per acre estimate for 1985:1984. Attack ratios greater than one indicate an increasing infestation trend; and, less than one a decreasing infestation trend.

FIGURE 1 - LOCATION OF MPB SURVEY AREAS



RESULTS

Table 1, 2, and 3 display 1985 mountain pine beetle trends for Grand, Summit and Eagle Counties, respectively. Where possible, the post-flight survey lines were established in the same areas as the brood survey plots. The Not Rock Sale area (Table 2) was the only plot to indicate an increasing population trend on the brood survey and was the only area to indicate an increasing attack ratio on the post-flight survey. All other areas indicated a static or decreasing trend on the brood survey and a decreasing attack ratio on the post-flight survey.

The brood survey indicated substantial beetle mortality occurred over the 1984-85 winter season. Of the 27 plots surveyed, 74 percent showed a declining population, 22 percent a static population, and 4 percent an increasing population. In each of the bark samples taken, numerous dead larvae were found at the end of short (1/2 inch long) galleries, indicating mortality occurred early in the overwintering period.

This declining trend was substantiated by the 50 percent project-wide decline in 1985 vs. 1984 attacked trees. In addition, more than 40 percent of the trees attacked in 1985 were classified as pitchouts (unsuccessful attacks) indicating either a general decline in beetle population viability or an increase in the trees ability to resist beetle attack.

TABLE 1. MOUNTAIN PINE BEETLE INFESTATION TREND

GRAND COUNTY, COLORADO 1985

Plot	Attacked Trees 1/ Per Acre					
	1985	1984	1985 P.O.	Attack Ratio 85:84	Percent P.O.	Brood Trend
Stillwater Ck 1	2.2	5.5	1.2	0.4:1	35.3	Dec
Stillwater Ck 2	0	0.5	0.2	N/A	100.0	
Stillwater Vista						Dec
Silver Ck 1	9.0	11.5	4.5	0.8:1	33.3	
Silver Ck 2	14.6	25.4	9.2	0.6:1	38.6	Static
Tabernash C G	1.2	6.8	2.0	0.2:1	62.5	Dec
Meadow Ck	5.0	12.5	6.2	0.4:1	55.4	
Willow Ck						Dec
Doe Ck						Dec
Mt. Chauncey						Dec
Cottonwood Pass						Dec
Grouse Mtn						Dec
Horseshoe C G						Dec
Amax						Dec
Jolly Ck						Dec
Dice Hill 1						Dec
Dice Hill 2						Static
Mean	5.3	10.4	3.9	0.5:1	41.9	

1/ Not all brood plots were surveyed post-flight.

TABLE 2. MOUNTAIN PINE BEETLE INFESTATION TREND

SUMMIT COUNTY, COLORADO 1985

Plot	Attacked Trees 1/ Per Acre					
	1985	1984	1985 P.O.	Attack Ratio 85:84	Percent P.O.	Brood Trend
Sapphire 1	0.2	0.5	0.2	0.4:1	50.0	Dec
Sapphire 2						Dec
Peninsula	0.3	1.3	0.7	0.2:1	70.0	
Mesa Cortina	0.2	2.5		0.1:1	0	Dec
Not Rock Sale	9.2	8.0	2.8	1.2:1	23.3	Inc
Ute Pass	6.5	15.8	1.2	0.4:1	15.6	Static
Rock Ck						Dec
Brush Ck						Dec
Mean	3.3	5.6	1.0	0.6:1	23.2	

1/ Not all brood plots were surveyed post-flight.

TABLE 3. MOUNTAIN PINE BEETLE INFESTATION TREND

EAGLE COUNTY, COLORADO 1985

Plot	Attacked Trees 1/ Per Acre					
	1985	1984	1985 P.O.	Attack Ratio 85:84	Percent P.O.	Brood Trend
Hardscrabble Mtn	0.2	2.0	1.5	0.1:1	88.2	Dec
Tigiwon C G	Ø	3.4	0.4	N/A	100.0	Static
Red Mtn 1						Dec
Red Mtn 2						Dec
Bear Gulch						Static
Burnt Mtn						Static
Mean	0.1	2.7	1.0	0.04:1	90.9	

1/ Not all brood plots were surveyed post-flight.

Table 4 summarizes the mountain pine beetle infestation trend in the silviculturally treated stands surveyed within the project area. Three cutting strategies were examined:

1. Diameter limit cut - all trees greater than 8 inches
2. Diameter limit cut - all trees greater than 12 inches, 50% of trees 8 to 10 inches
3. Basal area cuts

All cut units surveyed were cut in 1984-85 prior to beetle flight except the Silver Creek units which were cut in 1983-84. The same decreasing trend noted in the general survey area was found in the treated stands.

TABLE 4. MOUNTAIN PINE BEETLE INFESTATION TREND

SILVICULTURALLY TREATED STANDS

HIGH COUNTRY PROJECT 1985

1. Diameter limit cut - all trees greater than 8 inches

Plot	Attacked Trees Per Acre				
	1985	1984	1985 1/ P.O.	Attack Ratio 85:84	Percent 1/ P.O.
Silver Ck 1	1.5	1.0	6.0	0.5:1	92.3
Silver Ck 2	2.7	6.3	4.3	0.4:1	61.4
Stillwater Ck 1	Ø	Ø	Ø	N/A	N/A
Stillwater Ck 2	Ø	Ø	Ø	N/A	N/A
2. Diameter limit cut all trees greater than 12 inches; 50% of trees 8 to 10 inches					
Meadow Ck	0.3	Ø	1.0	N/A	76.9
3. Basal area cuts					
Stillwater Ck 3	Ø	Ø	Ø	N/A	N/A
Stillwater Ck 4	Ø	Ø	Ø	N/A	N/A

1/ P. O. = Pitch Out

Figure 2 displays the estimated acres of lodgepole pine cover type by age class on USDA Forest Service administered lands within the High Country Project. 1/ There are an estimated 268,280 acres of cover type with 14.4 percent less than 80 years of age; 65.3 percent 80 to 140 years of age, and 20.3 percent greater than 140 years of age. The three factors for determining stand susceptibility to mountain pine beetle are average diameter, elevation-latitude and stand age. Stands in excess of 80 years of age are considered to be highly susceptible - over 86% of the stands in the High Country Project area or more than 350,000 acres.

Over the last 80 years, regeneration has occurred on about 4830 acres per decade. Regeneration by decade for the past 80 years is displayed in Figure 3. The peak in regeneration acres occurred in the decade 1905-14 at 18,670 acres. A steady decline occurred through the 1935-44 decade low of 590 acres. Regeneration acres increased over the next three decades by more than two-fold per decade to 6259 acres. A dramatic decline of nearly ten-fold occurred in the current decade. Assuming a pathological rotation age of 300 years, an average of 8942 acres per decade need to be regenerated to maintain the current extent of the lodgepole pine cover type within the project area. To make a significant impact on mountain pine beetle stand susceptibility, moderate to low susceptibility, 33,500 acres need to be regenerated per decade (80 year rotation).

Acres of Forest Service administered lodgepole pine cover type are estimated to be about two-thirds of the total cover type within the project area. Age class distributions on the approximately 140,000 additional acres of cover type would not be expected to be significantly different, proportionally, from the distributions represented in Figure 2. Therefore to maintain the cover type, an additional 4600 would need to be regenerated each decade (300 year rotation); and, to make a significant impact on mountain pine beetle stand susceptibility, moderate to low susceptibility, 17,500 acres need to be regenerated per decade (80 year rotation).

1/ From the RIS Data Base

FIGURE 2

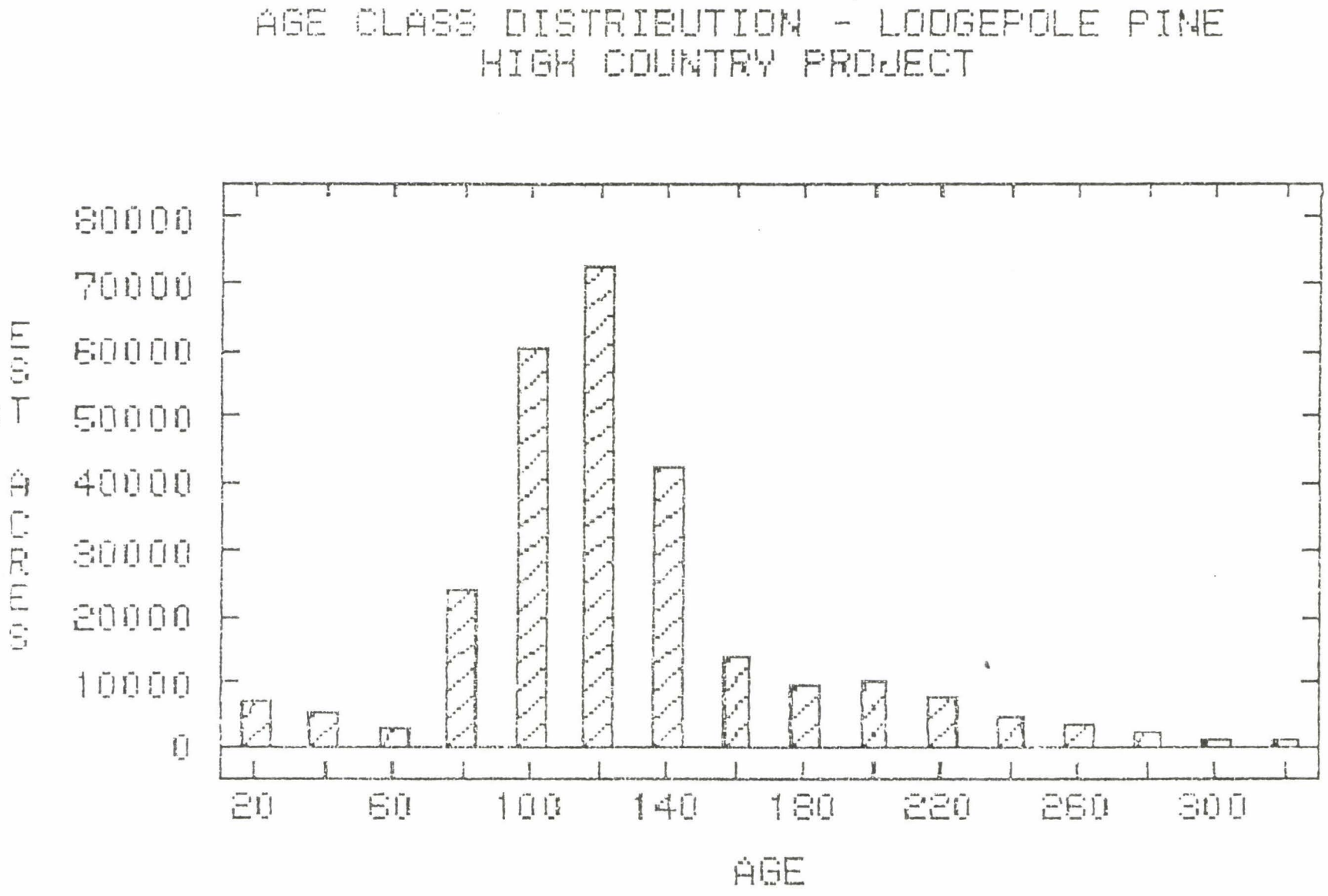
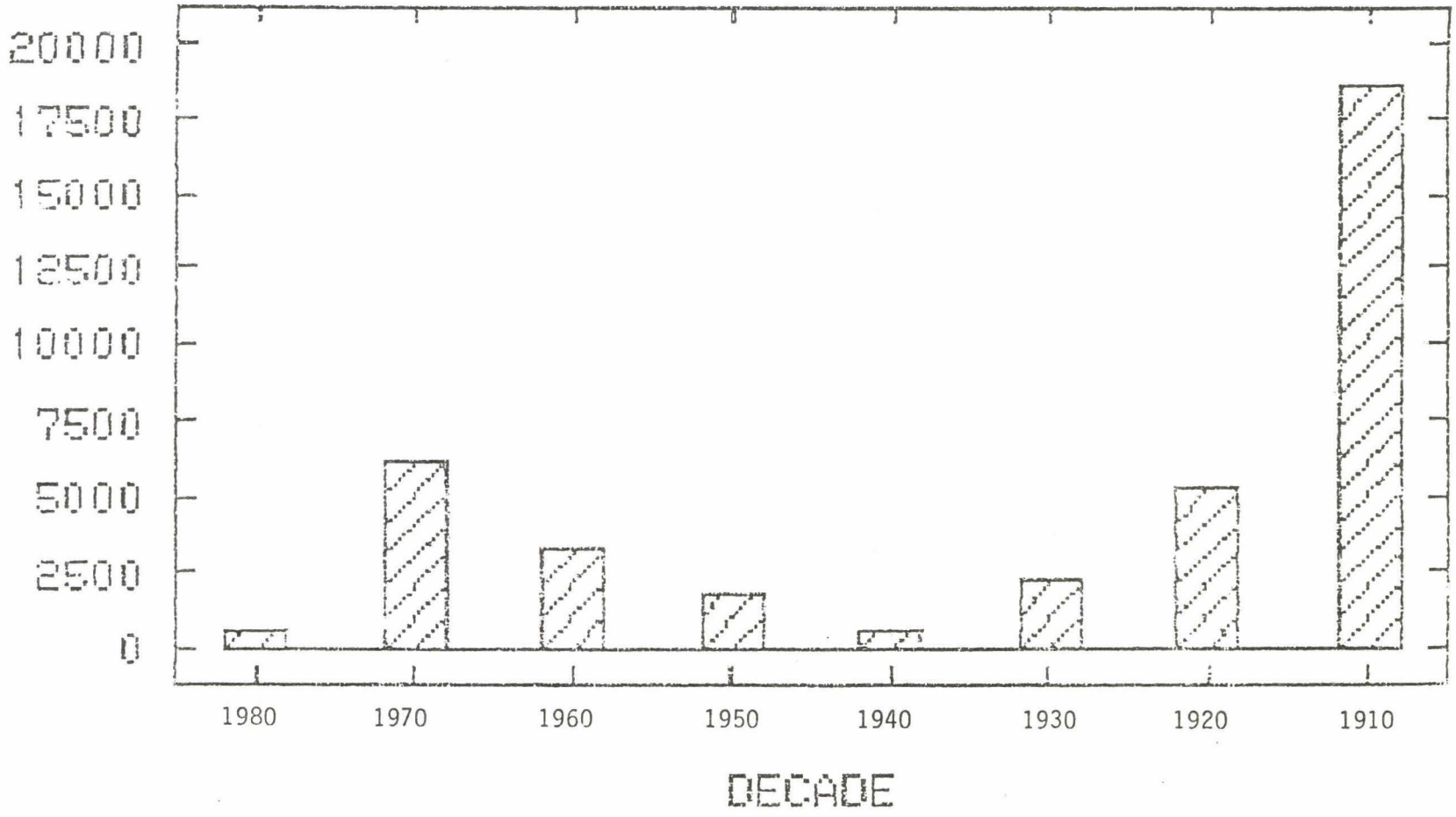

AGE CLASS DISTRIBUTION - LODGEPOLE PINE
HIGH COUNTRY PROJECT
80000
70000
60000
50000
40000
30000
20000
10000
0
20
60
100
140
180
220
260
300
AGE

FIGURE 3

ACRES OF REGENERATION - LODGEPOLE PINE BY DECADE FOR THE HIGH COUNTRY PROJECT



The primary consequence of continuing to maintain vast acres of mature and over mature lodgepole pine stands are an increase of tree mortality due, not only to mountain pine beetle, but also dwarf mistletoe and Armillaria root disease. This increased mortality will provide substantial fuel loading and a consequent high potential for catastrophic fire.

RECOMMENDATIONS

The declining mountain pine beetle population offers a prime opportunity to shift emphasis from suppression to timber stand improvement and stand regeneration. The main goal should be to substantially reduce the number of acres at risk to insects, disease and fire. Currently, there are about 230,000 acres of lodgepole pine cover type greater than 80 years of age on USDA Forest Service administered lands. If maintenance of the lodgepole pine cover type is the primary objective, then a minimum of about 9,000 acres per decade needs to be regenerated. Additional acres of type on state, private and other Federal lands, also, are in need of treatment.

Suppression of wildfire over the past 80 years has been the driving force in increasing the age of the lodgepole pine cover type. In addition, fire suppression has increased the extent of the lodgepole pine type through encroachment into grasslands, meadows and the aspen cover type.

Prescribed fire should be considered as a silvicultural tool to reduce encroachment and increase species diversity; and, to reduce the average age of the lodgepole pine component thus increasing age class diversity.

USDA Forest Service should review rotation ages for the lodgepole pine cover-type by management prescription. On each of the three National Forests involved in the High Country Project only two management prescriptions (7D and 10E) have rotation ages which have an opportunity to reduce and maintain lodgepole pine stands in the less than highly susceptible category (Table 5).

TABLE 5. ROTATION AGES GIVEN IN FOREST PLANS BY MANAGEMENT PRESCRIPTION FOR LODGEPOLE PINE

MANAGEMENT PRESCRIPTION	ROTATION AGE BY NATIONAL FOREST		
	ROUTT	ARAPAHO/ ROOSEVELT	WHITE RIVER
1B - Existing and potential winter sports sites	90 - 140	100 - 180	90 - 140
2A - Semi-primitive motorized recreation	100 +	100 - 180	90 - 140
2B - Rural and roaded - natural recreation	100 +	100 - 180	90 - 140
3A - Semi-primitive nonmotorized in roaded and nonroaded areas	90 - 140	100 - 180	90 - 140
4B - Habitat for management indicator species	90 - 140	90 - 140	90 - 140
4C - Wildlife habitat in woody draws and other woody vegetation areas on rangeland	90 - 140	--	--
5B - Big game winter range in forested areas	90 - 140	90 - 140	90 - 140
6A - Improving rangeland to satisfactorily condition	--	--	90 - 140
6B - Livestock grazing	90 - 140	90 - 140	90 - 140
7C - Management of forested areas on steep slopes	90 - 180	--	--
7D - Wood fiber production and utilization for products other than sawtimber	50 - 90	50 - 90	50 - 90
7E - Wood fiber production and utilization	90 - 140	--	90 - 140
9A - Riparian area management	90 - 160	90 - 160	90 - 160
9B - Increased water yield through vegetation treatment	90 - 180	100 +	100 +
10E - Municipal and supply watersheds	60 - 120	--	--

LITERATURE CITED

Averill, R. D. and Dave Leatherman. 1983. Mountain pine beetle in Grand County, Colorado - 1983. USDA For. Serv. Bio. Eval. R2-83-6. 7 pp.

Cole, Walter E. 1964. The mountain pine beetle in lodgepole pine (Dendroctous monticolae Hopk.) (Coleoptera: Scolytidae). Study Plan I. Development of sampling procedures. USDA For. Serv., Int. Sta., Ogden, UT

Cole, Walter E., Donn B. Cahill, and Gene Lessard. 1983. Harvesting strategies for management of mountain pine beetle infestations in lodgepole pine. Preliminary evaluation, East Long Creek Demonstration Area, Shoshone National Forest, Wyoming. USDA For. Serv. Res. Note INT-333. 11 pp.

APPENDIX A

A Revised Strategy

Mountain pine beetle (Dendroctonus ponderosae Hopk.) is endemic to lodgepole pine (Pinus cortorta Dougl.), ponderosa pine (P. ponderosa Laws.) and limber pine (P. flexilis James) in Colorado. Tree mortality caused by this insect will continue to occur where there are suitable host tree speices. The key to managing the insect-host complex is to reduce tree mortality to some acceptable level. An acceptable level of tree mortality will vary in accordance with the goals and objectives of the land manager for specific land areas. Therefore, management strategies must be developed which consider a wide range of management objectives and land use values.

Using decision analysis, a procedure was developed to match management strategy to a land classification system (Freeling and Seaver, 1980). The procedure first develops a land classification system based on the following criteria:

1. Risk to mountain pine beetle (MPB) infestation
2. Land accessibility (and/or operability)
3. Tree value

The eight land classification categories developed were:

A. Moderate to high MPB risk
   Accessible
   High individual tree value

B. Moderate to high MPB risk
   Accessible
   Low individual tree value

C. Moderate to high MPB risk
   Inaccessible
   High individual tree value

D. Moderate to high MPB risk
   Inaccessible
   Low individual tree value

E. Low risk to MPB
   Accessible
   High individual tree value

F. Low risk to MPB
   Accessible
   Low individual tree value

G. Low risk to MPB
   Inaccessible
   High individual tree value

H. Low risk to MPB
   Inaccessible
   Low individual tree value

The criteria used to develop the land classification system are qualitative. However, each can be quantified. Since this is a dynamic classification scheme, it will need to be updated to keep pace with tree growth (risk), improved harvesting technology, and changing land use values.

Mountain pine beetle risk - There are three published schemes for risk rating mountain pine beetle in lodgepole pine (Amman et al. 1977; Waring and Pitman 1980; Schenk et al 1980). To date Amman et al (1977) is the most reliable scheme to estimate stand risk to mountain pine beetle. In addition this scheme is available on computer using Stage II data.

Accessibility - Accessibility implies operability. Both accessibility and operability vary with the management strategy selected and the equipment available to implement the strategy. As an example, slopes in excess of 40% may be inoperable to conventional logging equipment but operable for a high lead system; or, operable for chemical pesticide application.

Tree Value - Value systems are highly variable and often difficult to quantify. The goals and objectives established for an area determine the value system(s) to be used (ie, recreation and aesthetics, wildlife habitat, wood fiber, etc.). Thus, a given piece of land and tree resource will have a value affected by tree density, and quality, and land use. Effects of the mountain pine beetle may enhance or detract from that value. The objective is to minimize the loss of the resource value from mountain pine beetle through the application of one or more strategies. For mountain pine beetle there are three preventative strategies:

1. Thinning of stands
2. Preventative spraying
3. Favoring tree species other than the host species

and one suppression strategy:

1. Direct control-actions taken to reduce the population immediately.

Inherent in these management strategies is their applicability, or more properly, their nonapplicability on some land classifications. As an example, direct chemical treatment of low risk, low value trees over large

inaccessible areas would be inefficient economically and therefore inappropriate.

Five major premises were developed using decision analysis (Freeling and Seaver, 1980):

1. All host type, regardless of ownership can be stratified into land classification units.

2. Mountain pine beetle cannot be controlled by any method over extensive areas of land.

3. Management and control of MPB is viable in restricted areas of type having relatively high value.

4. The ideal strategy for managing mountain pine beetle is to intensively manage the host type, thereby preventing outbreaks from occurring.

5. Prevention is a viable strategy only in moderate to high susceptible stands or in low susceptible stands which will be in a moderate to high susceptible condition in the near future.

Failure to recognize these premises will lead to failure for any long range management of mountain pine beetle.

Management opportunities identified in the decision analysis process (Freeling and Seaver 1980) were:

1. Incorporate into Forest plans management prescriptions for the major insects and diseases causing tree damage in the Region.

2. Involve State and local governments to a greater degree in future planning efforts.

3. In cooperation with Federal, state and local governments and private landowners implement a management program to prevent and suppress the mountain pine beetle on all lands in land classifications A, B, C, and E using the following recommended strategies.

Land Classification A - On developed recreation areas where mountain pine beetle is present, the preferred strategy is to suprpess the insect by harvesting infested trees before beetle flight. On developed recreation areas where an epidemic has run its course, the preferred strategy is to do nothing. If an epidemic has not yet occurred, thinning is recommended. This reduces the susceptibility of the area to mountain pine beetle.

On type A areas other than developed recreation sites, the preferred suppression strategy is thinning for prevention, or harvesting of infested trees. In areas where the beetle is already epidemic, the preferred strategy is dependent upon tree value and recreation values. If the recreational value is greater than about six times the stumpage value (acre basis), then suppression is best. With lower recreation values, however, thinning is the preferred strategy. In areas where the beetle is either not present, or inactive, thinning is preferred, as thinning may prevent beetle epidemics. In particular, immediate thinning is much preferred to waiting for an epidemic to start and then thin. Thorough analysis of the benefits and costs of the various tactics in relation to the value of the management objectives will aid in development of the preferred approach to suppression in a given situation.

Land Classification B - In these areas a thinning program is the preferred strategy. This is due largely to the beneficial silvicultural effects and reduce detrimental recreation effects.

Land Classification C - In these areas where thinning is impractical due to contstraints on accessibility and operability, suppression by chemical means is considered the best strategy under epdiemic conditions. However, this stragey is only marginally superior to doing nothing and accepting the losses.

Land Classification E - On these low MPB susceptibility areas, harvesting infested trees is the preferred strategy. Because these are high value lands, this strategy is effective in reducing the impacts on scenic, recreational and real-estate value.

In summary, the greatest benefit appears to be from thinning programs in those highly susceptible areas where beetles are not present, but there is also some net benefit from continuing with suppression efforts in those higher value areas where beetles are present.

4. On land classification areas D, F, G, and H allow the mountain pine beetle to run its course.

5. Initiate and maintain a continuous program of unified management on all lands.

APPENDIX B

The prescriptions presented here are a result of an interagency task force composed of entomologists, silviculturists, pathologists, and foresters from the CSFS and USDAFS. These prescriptions were developed in 1981 and have been applied to several locations in Summit, Colorado.

GENERAL PRESCRIPTION

The purpose of the general prescription is to describe the ecological situation in which epidemic outbreaks of mountain pine beetle are least likely to occur and to provide a guiding framework for the more specific stand prescriptions. The following objectives are included in the general prescription:

1. Establish a diverse mosaic of stand size classes, age classes, and species mixtures.

2. Design this mosaic for an aesthetically pleasing appearance and for productive wildlife habitat conditions.

3. Make a long term commitment for management to avoid stand conditions susceptible to epidemic outbreaks. This can partially be accomplished through Forest Plans.

4. Provide access needed for stand management, now and in the future.

5. Salvage felled or killed trees to the extent possible.

6. Maintain and improve visual quality through varying stand shapes and sizes, removing of visually dominant dead trees, and increasing species diversity of the vegetation.

7. Replace susceptible lodgepole pine in recreation or high use areas through planting of species appropriate to site conditions. This may include planting of lodgepole pine, other conifers, leaving created openings, or planting species beneficial to wildlife and aesthetics.

8. Develop specific long term vegetation management plans for ski areas or other high-value developed sties.

9. Prioritize stands for treatment using the risk ratings shown in "Guidelines for Reducing Losses of Lodgepole Pine to the Mountain Pine Beetle in Unmanaged Stands in the Rocky Mountains" by Amman, McGregor, Cahill and Klein, 1977, USDA Forest Service, Gen. Tech. Rpt. INT-36, Intermountain For. and Rng. Expt. Stn., Ogden, UT.

10. Insects in currently infested trees may be directly controlled using chemical, mechanical, or burning methods in combination with silvicultural methods.

11. Reduce existing and resultant highly hazardous fuel accumulations.

12. Re-examine stands for effectiveness of treatment methods within 5 years of accomplishment.

The following prescriptions were developed for stand conditions anticipated with the project area. These prescriptions are qualified by the fact that not all conditions can be anticipated and owner objectives for specific locations may preclude application of the recommended treatments. Nevertheless, the prescriptions are judged to have the best potential for containing the present outbreak of mountain pine beetle.

Figure 1

PRESCRIPTION NUMBERS FOR MAJOR CONDITIONS AND SITUATIONS ANTICIPATED IN PROJECT AREA

Stand Condition	Forest Situation		
	Undeveloped Forest*	Developed Forest*	Wilderness
Susceptible LPP (7" d.b.h. +)			
Without manageable understory	1	2	11
With manageable understory	3	4	11
At least 10% BA other species	5	6	11
Stagnated, Immature LPP	7	7	11
Immature LPP Responsive to Thinning			
(less than 70 years old, pointed crowns, 40%+ live crown)			
Pure lodgepole	8	8	11
At least 10% BA other species	9	9	11
Other Species			
Less than 30% LPP	10	10	11

* Undeveloped forest is land where recreation and amenity values do not greatly exceed those of other resources. Developed forest is land where recreation values are very high and includes campgrounds, roadside zones, ski areas, private lands held for recreation purposes, or other developed sites.

Prescription No. 1

Susceptible Lodgepole Pine Without Understory - Undeveloped Forest

1. Cutting Methods:
   A. Clearcut stands up to 40 acres to size
   B. Patch cut within stands with cut units up to 10 acres in size

All basal area of lodgepole pine would be removed in both treatments.

2. Slash Disposal and Site Preparation Methods:
   A. Lop and scatter slash
   B. Salvage for firewood

3. Regeneration Methods:
   Natural regeneration

4. TSI Methods;
   Not applicable

5. Other Treatments:
   A. Salvage any uncut areas within stands
   B. Fell unmerchantable trees infected with dwarf mistletoe

6. Constraints:
   Size of adjacent areas not clearcut should be approximately equal or larger in size to clearcut areas. Shapes will be influenced by appearance of the openings from important vantage points.

Prescription No. 2

Susceptible Lodgepole Pine Without Understory - Developed Forest

1. Cutting Methods:
   A. Patch cut within stands
   B. Shelterwood seed cut to basal area of 60 or less
   C. Thin from above removing most susceptible trees first to an approximate growing stock level of 80
   D. Thin from below to an approximate growing stock level of 80

2. Slash Disposal and Site Preparation methods:
   A. Pile and burn
   B. Physical removal
   C. Lop and scatter
   D. Salvage for firewood

3. Regenerating Methods:
   A. Natural regeneration
   B. Plant species best suited to site

4. TSI Methods:
   Fell unmerchantable lodgepole in thinning treatments as needed to meet growing stock level objective.

5. Other Treatments:
   Preventative treatments with chemicals.

6. Constraints:
   A. Size of patch cuts to be constrained by location, appearance, and owner objectives.
   B. Partial cuts constrained by windthrow susceptibility, dwarf mistletoe infection level, owner objective, or other on-site condition.

Prescription No. 3

Susceptible Lodgepole Pine With Manageable Understory - Undeveloped Forest

1. Cutting Methods:
   A. Removal cut taking all lodgpeole pine in excess of 7 inches d.b.h.
   B. Removal cut in stages, taking the most susceptible lodgepole pine in the first cut

2. Slash Disposal and Site Preparation Methods:
   A. Lop and scatter
   B. Salvage for firewood

3. Regeneration methods;
   Not applicable

4. TSI Methods;
   A. Thin understory if needed
   B. Remove mistletoe infected lodgepole in understory

5. Other Treatments:
   None

6. Constraints:
   Size and shape of opening may be constrained as in clearcutting if understory is not of sufficient size to have visual significance.

Prescription No. 4

Susceptible Lodgepole Pine with Understory - Developed forest

1. Cutting Methods:
   A. Removal cut in stages removing the most susceptible lodgepole pine in the first cut
   B. Removal cut in one cut in patches up to 10 acres.

2. Slash Disposal and Site Preparation Methods:
   A. Pile and burn
   B. Physical removal
   C. Lop and scatter
   D. Salvage for firewood

3. Regeneration Methods:
   Not applicable

4. TSI Methods;
   A. Thin undrstory if needed
   b. Remove mistletoe infected lodgepole in understory

5. Other Treatments;
   Preventative spray

6. Constraints:
   Size and shape of opening in one cut removals will be determined by owner objective and visual impact.

Prescription No. 5

Susceptible Lodgepole Pine with Mixture of Other Species - Undeveloped Forest

1. Cutting Methods:
   A. Shelterwood seed cut to basal area of 60 or less, retaining mixed species for seed and shelter
   B. Improvement - salvage cut removing the most susceptible lodgepole and worst individuals of mixed species
   C. If mixed with aspen, patch cut lodgepole around the spen. Aspen may or may not be cut depending on situation. Remove lodgepole pine from aspen patches.

2. Slash Disposal and Site Preparation Methods:
   A. Lop and scatter
   B. Salvage for firewood

3. Regeneration Methods:
   Natural regeneration

4. TSI Methods:
   Weed and release felling to favor the mixed species

5. Other Treatments;
   None identified

6. Constraints:
   None indentified

Prescription No. 6

Susceptible Lodgepole Pine with Mixture of Other Species - Developed Forest

1. Cutting Methods:
   A. Improvement - salvage cut removing the most susceptible lodgepole pine and worst individuals of mixed species
   B. Shelterwood seed cut to basal area of 60 or less, retaining mixed species for seed and shelter
   C. Partial or patch cut to favor aspen only outside of campgrounds or other areas with heavy foot traffic

2. Slash Disposal and Site Preparation Methods:
   A. Pile and burn
   B. Physical removal
   C. Lop and scatter
   D. Salvage for firewood

3. Regeneration methods:
   A. Natural regeneration
   B. Plant species appropriate to site conditions, favor those other than lodgepole

4. TSI Methods:
   Weed and release felling to favor the mixed species

5. Other Treatments:
   Preventative Spray

6. Constraints:
   Site specific depending on location

Prescription No. 7

Stagnated Immature, Nonsusceptible - Undeveloped and Developed Forest (Judged not capable of release, generally more than 70 years old, rounded or tufted tops, less than 40% live crown, or DMR rating of 3.0 or more)

1. Cutting Methods:
   Defer treatment

2. Slash Disposal and Site Preparation Methods:
   Defer treatment

3. Regeneration methods:
   Defer treatment

4. TSI Methods:
   Defer treatment

5. Other Treatments:
   None identified

6. Constraints:
   None identified

Prescription No. 8

Immature, Responsive Lodgepole Pine - Undeveloped and Developed Forest

1. Cutting Methods:
   A. Precommercial thinning between August and March to a growing stock level of 110 or less
   b. Defer treatment

2. Slash Disposal and Site Preparation methods:
   A. Lop and scatter
   B. Salvage for firewood
   C. Pile and burn
   D. Chipping

3. Regeneration Methods;
   Not applicable

4. TSI Methods:
   A. Thin by felling
   B. Sanitize by felling mistletoe infected lodgepole

5. Other Treatments:
   None identified

6. Constraints: Site specific, depending on location.

Prescription No. 9

Immature, Responsive Lodgepole with 10% or More Other Species - Undeveloped and Developed Forest Sites

1. Cutting Methods:
   A. Precommerical thinning between August and March to a growing stock level of 110 or less. Favor other species to the extent possible.
   B. Defer treatment

2. Slash Disposal and Site Preparation Methods:
   A. Lop and scatter
   B. Salvage for firewood
   C. Pile and burn
   D. Chipping

3. Regeneration Methods:
   Not applicable

4. TSI Methods:
   Not applicable

5. Other Treatments:
   Preventative chemical spray on developed Forest sites

6. Constraints:
   None identified

Prescription No. 11

All Stand Conditions - Wilderness

Method:
Prepare a biological assessment of potential for outbreak and possible treatment alternatives.

Slash Disposal and Site Preparation Methods:
Not applicable

Regeneration Methods:
Not applicable

TSI Methods:
Not applicable

Other Treatments:
None identified pending results of biological assessment

Constraints:
Associated with Wilderness Act